Clinical Anaesthesiology

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General Anaesthesia

Classification of General Anaesthesia
Methods

Inhalation anaesthesia
Intravenous anaesthesia
Intramuscularly
Rectally
Orally
Balanced anaesthesia

Clinical Pharmacology
Inhalational anaesthetic agents

Agent	MAC%	Vapor Pressure	Blood/Gas Partition
Nitrous oxide	105	-	0.47
Halothane	0.74	243	2.4
Enflurane	1.68	175	1.9
Isoflurane	1.15	240	1.4
Desflurane	6.0	681	0.42

Clinical Pharmacology
Intravenous anaesthetic agents

Agent	Induction dose (mg·kg-1)
Thiopentone	3-5
Methohexitone	1-1.5
Etomidate	0.3
Propofol	1.5-2.5
Ketamine	2


1mg/ml
阿托品
0.5mg/ml
麻黄素
10mg/ml

Clinical Pharmacology
Drugs used to supplement anaesthesia

Analgesics

Opioid agonists

- Natural opium alkaloids: Morphine,Codeine
- Semisynthetic opium alkaloid: Diamorphine
- Synthetic opioids:Pethidine, Fentanyl, Alfentanil, Sufentanil, Remifentanil

Partial opioid agonists

- Buprenorphine

Clinical Pharmacology
Drugs used to supplement anaesthesia

Opioid agonist/antagonists

- Pentazocine

Opioid antagonists

- Naloxone

Clinical Pharmacology
Muscle Relaxants

Neuromuscular blocking agents are dividedinto two classes:

- Depolarizing
- Nondepolarizing

Clinical Pharmacology
Muscle Relaxants

- Depolarizing
  - Short-acting
    - Succinylcholine
    - Decamethonium
- Nondepolarizing
  - Long-acting
    - Tubocurarine
    - Metocurine
    - doxacurium
    - Pancuronium
    - Pipecurium
  - Intermediate-acting
    - Atracurium
    - Vecuronium
  - Short-acting
    - Mivacurium

Clinical Pharmacology

Drugs affecting the autonomic nervous system

Sympathomimetic drugs

- Adrenaline(low-α,β_{1+2})(higher- α)
- Isoprenaline(β_{1+2})
- Noradrenaline(α,β_1)
- Phenylephine(α)
- Dopamine (low-δ,moderate-δ ,$\beta_{1+2,}$ moderatehigh-α,β_1)
- Dobutamine(β_1)

The practical conduct of anaesthesia

- Preparation for anaesthesia
- Equipment for monitoring
- The anaesthetic machine
- Equipment required for tracheal intubation

Anaesthetic apparatus
The anaesthesia machine

- Gas inlets & pressure regulators
- Oxygen pressure failure devices & oxygen flush valves
- Flow control valves
- Flowmeters & spirometers
- Vaporizers
- Vantilators & disconnect alarms
- Waste gas scavengers
- Humidifiers & nebulizers
- Oxygen analyzers

Airway management equipment

- Oral & Nasal airway
- Mask
- Endotracheal tube
- Rigid laryngoscopes
- Flexible fiberoptic laryngoscopes

Equipment required for tracheal intubation

- Correct size of laryngoscope and spare
- Tracheal tube of correct size + an alternative smaller size
- Tracheal tube connector
- Wire stilette
- Gum elastic bougies
- Magill forceps
- Cuff-inflating syringe
- Artery forceps
- Securing tape or bandage
- Catheter mount
- Local anaesthetic spray
- Cocaine spray/gel for nasal intubation
- Tracheal tube lubricant
- Throat packs
- Anaesthetic breathing system and face masks- tested with oxygen to ensure no leaks present

Induction of Anaesthesia

- Inhalational induction
- Intravenous induction

Inhalational induction agents

- Sevoflurane
- Desflurane

Induction of anaesthesia

Indications for inhalational induction

- Young children
- Upper airway obstruction
- Low airway obstruction with foreign body
- Bronchopleural fistula or empyema
- No accessible veins

Induction of anaesthesia

Difficulties and complications

- Slow induction of anaesthesia
- Problems particularly during stage 2
- Airway obstruction, bronchospasm
- Laryngeal spasm, hiccups
- Environmental pollution

Intravenous induction
Doses of the intravenous agents

Agent	Induction dose ($mg \cdot kg^{-1}$)
Thiopentone	3-5
Methohexitone	1-1.5
Etomidate	0.3
Propofol	1.5-2.5
Ketamine	2

Intravenous induction
Complications and difficulties

- Regurgitation and vomiting
- Intra-arterial injection of thiopentone
- Perivenous injection
- Cardiovascular depression
- Respiratory depression Histamine release
- Porphyria
- Other complications

Maintenance of anaesthesia

Inhalation anaesthesia with spontaneous ventilation

- Conduct
- Minimum alveolar concentration (MAC): MAC is the minimum alveolar concentration of an inhaled anaesthetic agent, which prevents reflex movement in response to surgical incision in 50 % of subjects.

Clinical Pharmacology

Inhalational anaesthetic agents

Agent	MAC%	Vapor Pressure	Blood/Gas Partition
Nitrous oxide	105	-	0.47
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Signs of anaesthesia

- Stage 1(Stage of analgesia): From start of induction of anaesthesia to loss of consciousness.
- Stage 2 (Stage of excitement): From loss of consciousness to beginning of regular respiration.
- Stage 3 (Surgical anaesthesia): From the beginning of regular respirationto respiratory arrest.

Signs of anaesthesia

- The stage 3 is divided into four planes.
  Plane 1: From the onset of regular breathing to the cessation of eyeball movements.
  Plane 2: From the cessation of eyeball movements to the beginning of intercostal paralysis.
  Plane 3: From the beginning of intercostal paralysis to the completion of intercostal paralysis.
  Plane 4: From completion of intercostal paralysis to diaphragmatic paralysis.

Signs of anaesthesia

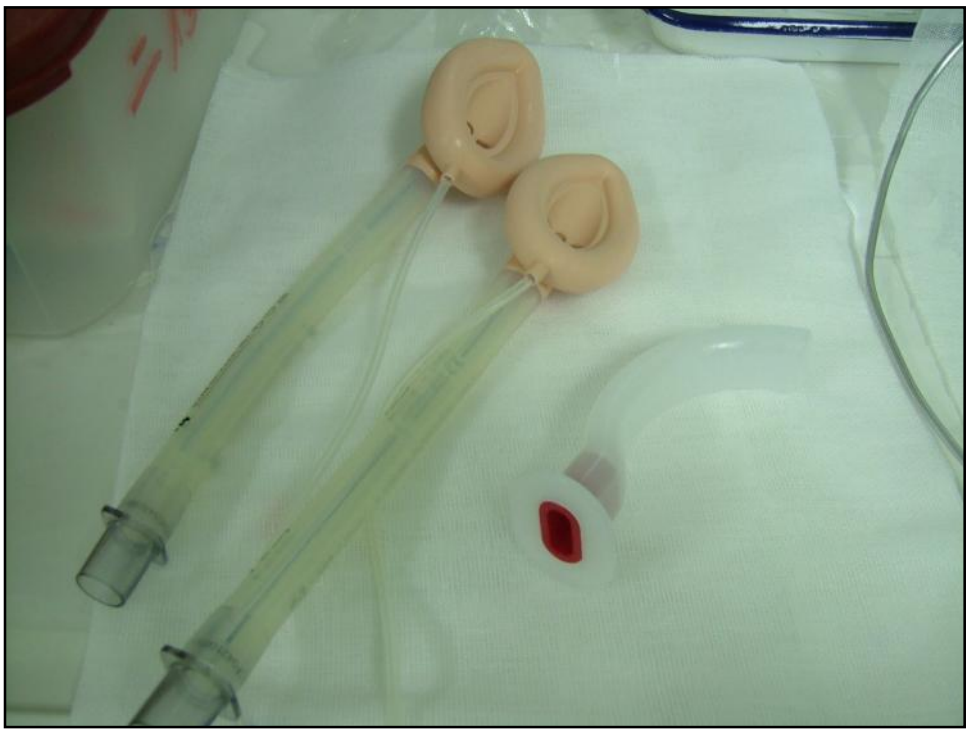
- Stage 4: Stage of impending respiratory and circulatory failure (Medullary paralysis), from the onset of diaphragmatic paralysis to cardiac arrest.

Inhalation anaesthesia with spontaneous ventilation
Complications and difficulties

- Airway obstruction
- Laryngeal spasm
- Bronchospasm
- Malignant hyperthermia
- Raised intracranial pressure (ICP)
- Atmospheric pollution

Delivery of inhalational agents- airway maintenance

- Use of the facemask
- Use of the laryngeal mask airway (LMA)
- Use of the oropharyngeal airway
- Tracheal intubation



Use of the laryngeal mask airway (LMA) Indications

- Provide a clear airway without the need for the anaesthetist's hands to support a mask.
- Avoid the use of tracheal intubation during spontaneous ventilation.
- In a case of difficult intubation to facilitate subsequent insertion of a tracheal tube either via the LMA or after use of a gum elastic bougie.

Use of the laryngeal mask airway (LMA) Contraindications

- A patient with a "full stomach" or with any condition leading to delayed gastric emptying,
- A patient in whom regurgitation of gastric contents into the esophagus is possible,
- Where surgical access is impeded by the cuff of the LMA.

Tracheal intubation
Indications

- Provision of a clear airway,
- An ‘unusual’ position,
- Operations on the head and neck,
- Protection of the respiratory tract,
- During anaesthesia using IPPV and muscle relaxants
- To facilitate suction of the respiratory tract
- During thoracic operations


CO2
ET 37 FI 1
RR 10 /min
MAC
Calibrate Agent I
Adult
MAC N20% Iso%
20
ET 1.0 0 1.1
20 0
FI 0 1.9

Tracheal intubation
Contraindications

Few

Anaesthesia for tracheal intubation

- Inhalational technique for intubation
- Relaxant anaesthesia for intubation

Anaesthesia for tracheal intubation

- Oral-tracheal intubation
- Nasotracheal intubation
- Flexible fiberoptic nasotracheal intubation

Complications of intubation
During laryngoscopy and intubation

- Maipositioning
  - Easophageal intubation
  - Endobronctrial intubation
  - Laryngeal position
- Airway trauma
- Tooth damage
- Lip, tongue or mucosal laceration
- Sore throat
- Dislocated mandible

Complications of intubation
During laryngoscopy and intubation

- Retropharyngeal dissection
- Physiologic reflexes
  - Hypertension,
  - Tachycardia
  - Intracranial hypertention
  - Intraocular hypertension
- Laryngospasm
- Tube malfunction
- Cuff perforation

Complications of intubation
While the tube is in place

- Malposition
- Unintentional extubation
- Endobrochial intubation
- Laryngeal cuff position
- Airway trauma
- Mucosal inflammation and ulceration
- Excoriation of nose
- Tube malfunction
- Ignition
- Obstruction

Complications of intubation
Following extubation

- A) Airway trauma
- Edema and stenosis (glottic, subglottic, or tracheal)
- Hoarseness (vocal cord granuloma or paralysis)
- Laryngeal malfunction and aspiration
- B) Physiologic reflexes Laryngospasm

Relaxant anaesthesia

Indications for relaxant anaesthesia

- Major abdominal, intraperitoneal, thoracic, intracranial operations
- Prolonged operations in which spontaneous ventilation would lead to respiratory depression
- Operations in a position in which ventilation is impaired mechanically

Clinical Pharmacology

Muscle Relaxants

- Depolarizing
  - Short-acting
    - Succinylcholine
    - Decamethonium
- Nondepolarizing
  - Long-acting
    - Tubocurarine
    - Metocurine
    - doxacurium
    - Pancuronium
    - Pipecurium
  - Intermediate-acting
    - Atracurium
    - Vecuronium
  - Short-acting
    - Mivacurium

Reversal of relaxation

Residual neuromuscular block is antagonized with neostigmine 2.5-5mg (0.05-0.08mg·kg^{-1} in children). Atropine 1.2mg or glycopyrronium 0.5mg counteracts the muscarinic side effects of the anticholinesterase and may be given before, or with, neostigmine.

Conduct of extubation

- Coughing
- Resistance to the presence of the tracheal tube

Complications of tracheal extubation

- Laryngeal spasm
- Regurgitation

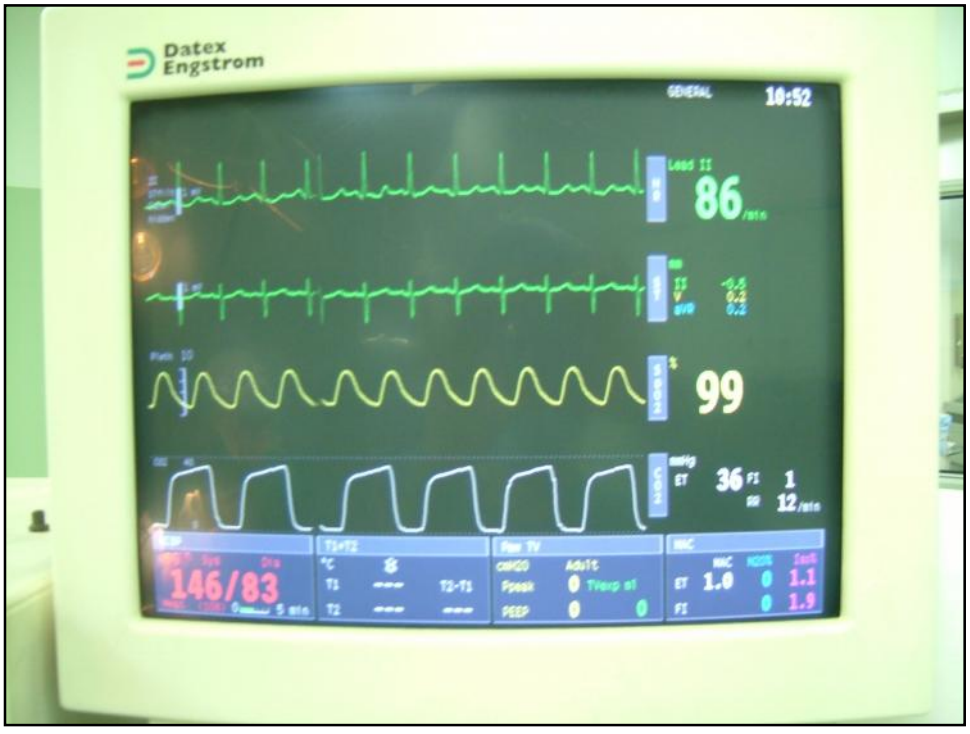
Emergence and recovery

- Testing hand grip
- tongue protrusion
- Lifting the head from the pillow in response to command

Monitoring during anaesthesia

Cardiac monitors

- Arterial blood pressure
  - Noninvasive arterial blood pressure
  - Invasive arterial blood pressure monitoring
- Electrocardiography
- Central venous catheterization
- Pulmonary artery catheterization
- Cardiac output



Noninvasive arterial blood pressure monitoring

Technique

- Palpation
- Doppler probe
- Auscultation
- Oscillometry
- Plethysmography
- Arterial Tonometry

Selection of artery for cannulation

- Radial artery
- Brachial artery
- Ulnar artery
- femoral artery
- Dorsalis pedis
- Posterior tibial artery
- Axillary artery

Invasive arterial blood pressure monitoring

Complications

- Hematoma
- Vasospasm
- Arterial thrombosis
- Embolization of air bubbles or thrombi
- Skin necrosis overlying the catheter
- Nerve damage
- Infection
  Unintentional intra-arterial drug injection

Monitoring during anaesthesia
Respiratory system monitoring

- Precordial & easophageal stethoscope
- Breathing circuit pressure & exhaled tidal volume
- Pulse oximetry
- End-tidal carbon dioxide analysis
- Transcutaneous oxygen & carbon dioxide monitors
- Anaesthetic gas analysis

Monitoring during anaesthesia
Neurologic system monitors

- Electroencephalography
- Evoked potential

Monitoring during anaesthesia
Miscellaneous monitors

- Temperature
- Urine output
- Peripheral nerve stimulation

Complications during anaesthesia

Arrhythmias

- Bradycardia
- Tachycardia
- Atrial arrhythmias
- Ventricular arrhythmias (Premature ventricular contractions (PVCs))
- Heart block

Complications during anaesthesia

Hypotention

- Decreased cardiac output:
- Decreased venous return
- Myocardial
- Vasodilation
- Drugs
- Septicaemia
- Hypovolaemia
- Haemorrhage

Complications during anaesthesia

- Hypertension
- Hypervolaemia
- Myocardial ischaemia
- Cardiac arrest
- Embolism
- Hypoxaemia

Complications during anaesthesia

- Hypercapnia
- Hypocapnia
- Respiratory obstruction
- Intubation problems Aspiration of gastric contents
- Hiccups
- Adverse drug effects

Complications during anaesthesia

- Malignant hyperthermia (MH)
- Hyperthermia
- Hypothermia
- Acute intermittent porphyria(AIP)
- Awareness
- Injury

Questions

- What is the meaning of MAC?
- What are the Guedel's classic signs of anaesthesia?
- How many methods for the anaesthetists use to maintain the airway? What are they?

Questions

- What are the indications for tracheal intubation?
- What are the complications during general anaesthesia?

Any Question?

THANK YOU !